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LIFESPAN OF BUTTERFLIES

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Abstract. Expected lifespan was found from survival rates estimated from mark-recapture experiments of 26 species. Expected lifespan is only about 7-12 days in temperate species without adult diapause or hibernation; females usually live slightly longer than males. Hot weather decreased lifespan of three species. Some tropical species live several months. Long life of up to 8 months can occur in temperate species hibernating as adults. Some temperate and tropical species aestivate for several months as adults in dry periods.

INTRODUCTION

Lifespan is a crucial parameter for the survival of butterflies. This paper shows that, except for some tropical species and species with adult aestivation or hibernation, expected (average) lifespan is only about 7-12 days (of course some individuals die sooner or live much longer). Because the preoviposition period of females is usually 3-8 days (Scott, 1973a), females therefore have an average of only about 4-9 days to oviposit, including days of bad weather.

METHODS

This paper is based on my mark-recapture studies of eleven species, details of which will be reported elsewhere, and those of previous authors. Lifespan is estimated from survival rates found from mark-recapture experiments using either the method of Fisher and Ford (1947) or of Jolly (1966). Single overall survival-rate estimates were obtained from daily survival estimates provided by Jolly's method by using method 1 of Scott (1973b). All of the studies using the Fisher-Ford and Jolly methods assumed a survival rate independent of age, but survival rate may actually decrease somewhat with age. Since the maximum lifespan of most species studied is three or more times the expected lifespan (Frohawk, 1934; this paper), the assumption of independence may be reasonable.

RESULTS

Species without adult diapause or hibernation. Since butter-

flies when first marked are almost always post-teneral (because teneral individuals seldom fly), the teneral period of about a day must be added to the lifespan in Table 1. With this teneral period added, expected lifespan is about 7-12 days for species without adult diapause or hibernation. The only known exceptions are tropical species: *Heliconius* lives up to six months, several Ithomiinae (*Ithomia pellucida* and *Hypothyris euclea*) live up to four months (Lawrence Gilbert, oral communication); *Morpho* and *Battus* live several months. The short lifespan means that the mating system must be efficient to minimize waste of time, and that most females die before laying all their eggs. *Parnassius, Parides, Heliconius,* and *Danaus* are probably unpalatable to vertebrates, but this has not increased their lifespan; *Heliconius* may live longer due to pollen feeding as adults (Gilbert, 1972).

Affect of weather on lifespan. In *Amblyscirtes simius* and *Neominois ridingsi* the expected lifespan was less in 1970 than 1969 apparently because 1970 was hot. The hot weather probably increased mortality although it could have increased emigration, and therefore lowered the calculated survival rate, a small amount. The 1970 expected lifespan of *L. arota* is very low compared to that of *L. xanthoides* also probably because of very hot weather.

Lifespan of males versus females. There seems to be little difference between the expected lifespan of males and females in *Parides, Neominois, Heliconius, Hypolimnas,* and *Precis* (the female *Precis* recorded rate is lower probably because of greater emigration). In *Lysandra coridon,* males live slightly longer than females. In *Ascia, Hypaurotis, Lycaena arota, L. xanthoides, Lysandra bellargus, Argynnis paphia,* and *Amblyscirtes,* females live longer than males, much longer in three species. In several Satyrinae, females live several months longer than males (see adult diapause below). Because females disperse farther and usually faster than males, their emigration would tend to lower survival rate more than in males, which may mean that in some of the above species which appear to have similar lifespans, females may actually live longer. Therefore in general females live slightly longer than males. This may occur because males can fulfill their function (mating) rapidly, whereas the location of suitable larval host and the maturation of eggs are more time-consuming processes. Also the more conspicuous mate-locating behavior of males may expose them

to more predation. Longer lifespan of females may cause selection on males to be mostly sexual selection, while selection on females is more to survive predation.

Hibernation. Some temperate species hibernate: *Gonepteryx rhamni, G. cleopatra, Danaus plexippus, Anaea andria, Polygonia* spp., *Aglais urticae, Inachis io, Nymphalis* spp., *Vanessa atalanta* (Ford, 1945; Valetta, 1970; Klots, 1951). *G. cleopatra* and some *Polygonia* mate in fall and oviposit in spring (Valetta, 1970; Jon Pelham, oral communication); the other species mate in spring. All of these species hibernate with immature ovaries except perhaps *Anaea* (Baker, 1969).

Adult diapause. Some species have adult diapause in areas with a dry season. *Maniola jurtina* on islands west of Italy mates, males die, then females aestivate two months then oviposit (Scali, 1971). *Brintesia circe* (both are Satyrinae) also does this (Verity, 1919). In the dry season in Costa Rica, *Eurema daira* and *Hamadryas* spp. live several months (Paul Opler, oral communication). *Eurema daira, Mechanitis isthmia,* and many other species have immature ovaries during the dry season in Costa Rica (Orley Taylor, written communication). *Coenonympha tullia* may live many weeks in the dry season in California (Lawrence Gilbert, oral communication). Long adult life may evolve if larval mortality is greater than adult mortality over the same period.

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TABLE 1. Survival rates and expected lifespans in days (=-1/ln S, where S is survival rate, Cook et al., 1967) of butterflies based on mark-recapture experiments of species without adult diapause or hibernation.

d- accurate, due almost entirely to death rate
+- should be increased slightly due to a small amount of emigration
°- should be greatly increased due to large amount of emigration

SPECIES	SURVIVAL RATE	EXPECTED LIFESPAN	SOURCE
Parnassius phoebus ♂♂	.842	5.8+	Scott, this study
Parides neophilus ♂♂	.83	5.4°	Cook et al. 1971
" ♀♀	.76	3.6°	"
Parides anchises ♂♂	.76	3.6°	"
Ascia monuste ♂♂	5-6 days		Nielsen, 1961
" ♀♀	7-10 days		"
Euchloe ausonides ♂♂	.835	5.5+	Scott, this study
Neominois ridingsii 1969 ♂♂	.915	11.2d	"
" 1970 ♂♂	.807	4.7d	"
" 1970♀♀	.813	4.8d	"
Maniola jurtina, colony of 500♂♀	.75	3.5d	Dowdeswell et al 1949
" colony of 3000, ♂♀	.93	13.8d	"
" " 15000 ♂♀	.89	8.6d	"
Parage megera ♂♀	.789	4.2+	Parr et al 1968
Coenonympha tullia ♂♀	.70	2.8d	Turner 1963
Morpho spp.	several months		Young 1971
Heliconius erato ♂♂	.997	several mos.	Turner 1971
" ♀♀	.985	"	"
Danaus chrysippus ♂♀	.775	3.9°	Edmunds 1969
Hypolimnus misippus ♂♂	.649	2.3°	"
" 1965 ♀♀	.650	2.3°	"
" 1966 ♀♀	.665	2.4°	"
Argynnis paphia ♂♂	about 9 days		Magnus 1954a
" ♀♀	about 14 days		"

TABLE 1 (continued)

SPECIES	SURVIVAL RATE	EXPECTED LIFESPAN	SOURCE
Poladryas arachne ♂♂	.794	4.3+	Scott, this study
Precis coenia native males	.878	7.8+	"
bred and released males	.912	10.9+	"
" females	.897	9.2+	"
Hypaurotis chrysalus ♂♂	.803	4.6d	"
" ♀♀	.888	8.4d	"
Lycaena arota ♂♂	.763	3.7+	"
" ♀♀	.790	4.2+	"
Lycaena xanthoides ♂♂	.893	8.9d	"
" ♀♀	.932	14.2d	"
Polyommatus icarus ♂♀	.744	3.4+	"
" ♂♀	.83	5.4d	Dowdeswell, et al 1940
Lysandra bellargus June ♂♂	.79	4.2d	Davis, et al 1958
" September ♂♂	.90	9.5d	"
" June ♀♀	.92	12.0d	"
" September ♀♀	.91	10.6d	"
Lysandra coridon ♂♂	.86	6.6d	"
" ♀♀	.81	4.7d	"
Hesperia pahaska ♂♂	.741	3.3+	Scott, this study
Amblyscirtes simius 1969 ♂♂	.865	6.9d	"
" 1970 ♂♂	.822	5.1d	"
" 1970♀♀	.844	5.8d	"
Ochlodes snowi ♂♂	.875	4.1+	"
Battus bellus	several months		Young, 1972

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